FORM PTO-1390 (REV 10-94) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371	10873.754USWO
	U S APPLICATION NO (If known, see 37 C F R 1 5) to be assigned 09/889840

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/JP00/08316	November 24, 2000	December 13, 1999

TITLE OF INVENTION

INTERNAL MAGNETIC SHIELD AND CATHODE RAY TUBE

APPLICANT(S) FOR DO/EO/US

Hiroshi IWAMOTO; Shin-ichiro HATTA; Ryuichi MURAI; Masaki KAWASAKI; Shigeo NAKATERA; Tomohisa MIKAMI

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(l).
4. [ ] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [X] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [X] has been transmitted by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US)
6. [X] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [X] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] have been transmitted by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [X] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [X] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
    [ ] A SECOND of SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [X] Other items or information: form PCT/RO/101, form PCT/ISA/210, form PCT/IB/301, form PCT/IB/304, form PCT/IB/308

U.S. APPLICATION NO (If known, see 37 C F R. 1 5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
to be assigned 09/889840	PCT/JP00/08316	10873.754USWO

17. [X] The following fees are submitted:	CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492(a) (1)-(5)):		
Search Report has been prepared by the EPO or JPO **$860.00**		
International preliminary examination fee paid to USPTO (37 CFR 1.492(a)(1)) **$690.00**		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) **$710.00**		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(3)) paid to USPTO **$1000.00**		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	**$860.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	**$0.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	8 -20 =	0	X **$18.00**	**$0.00**	
Independent claims	2 -3 =	0	X **$80.00**	**$0.00**	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$260.00**	**$0.00**	
TOTAL OF ABOVE CALCULATIONS =				**$860.00**	
Reduction by 1/2 for filing by small entity, if applicable. Small entity status is claimed pursuant to 37 CFR 1.27				**$0.00**	
SUBTOTAL =				**$860.00**	
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f). +				**$0.00**	
TOTAL NATIONAL FEE =				**$860.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +				**$40.00**	
TOTAL FEES ENCLOSED =				**$900.00**	
				Amount to be: refunded	**$0.00**
				charged	**$0.00**

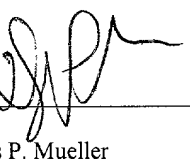
a. [X] Check(s) in the amount of $860.00 for filing fee and $40.00 for Assignment recordation to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. _____ in the amount of $ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 13-2725.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO
Douglas P. Mueller
MERCHANT & GOULD
P.O. Box 2903
Minneapolis, MN 55402-0903

SIGNATURE: 

NAME: Douglas P. Mueller

REGISTRATION NUMBER: 30,300

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

09/889840

JC17 Rec'd PCT/PTO 23 JUL 2001

Applicant: Iwamoto et al.

Docket: 10873.754USWO

Title: INTERNAL MAGNETIC SHIELD AND CATHODE RAY TUBE

CERTIFICATE UNDER 37 CFR 1.10
'Express Mail' mailing label number: EL669944417US
Date of Deposit: July 23, 2001
I hereby certify that this paper or fee is being deposited with the United States Postal Service 'Express Mail Post Office To Addressee' service under 37 CFR 1.10 and is addressed to the Commissioner for Patents, Washington, D.C. 20231.

By: Omesh Singh
Name: Omesh Singh

BOX PCT
Commissioner for Patents
Washington, D.C. 20231

Sir:

We are transmitting herewith the attached:

- ☒ Transmittal sheet, in duplicate, containing Certificate under 37 CFR 1.10.
- ☒ National Stage PCT Patent Application: Spec. 10 pgs; 8 claims; Abstract 1 pgs. The fee has been calculated as shown below in the 'Claims as Filed' table.
- ☒ 13 sheets of formal drawings
- ☒ A signed Combined Declaration and Power of Attorney
- ☒ Assignment of the invention to Matsushita Electric Industrial Co., Ltd., Recordation Form Cover Sheet
- ☒ A check in the amount of $860.00 to cover the Filing Fee
- ☒ A check for $40.00 to cover the Assignment Recording Fee.
- ☒ Other: Preliminary Amendment, copy of published application, form PTO-1390, form PCT/RO/101, form PCT/ISA/210, form PCT/IB/301, form PCT/IB/304, form PCT/IB/308
- ☒ Return postcard

CLAIMS AS FILED

Number of Claims Filed		In Excess of:		Number Extra		Rate		Fee
Basic Filing Fee								$860.00
Total Claims								
8	-	20	=	0	x	18.00	=	$0.00
Independent Claims								
2	-	3	=	0	x	80.00	=	$0.00
MULTIPLE DEPENDENT CLAIM FEE								$0.00
TOTAL FILING FEE								$860.00

Please charge any additional fees or credit overpayment to Deposit Account No. 13-2725. A duplicate of this sheet is enclosed.

By: _____
Name: Douglas P. Mueller
Reg. No.: 30,300
Initials: DPMueller/jlc

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23552
PATENT TRADEMARK OFFICE

(PTO TRANSMITTAL - NEW FILING)

S/N unknown

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Iwamoto et al.	Docket No.:	10873.754USWO
Serial No.:	unknown	Filed:	concurrent herewith
Int'l Appln No.:	PCT/JP00/08316	Int'l Filing Date:	November 24, 2000
Title:	INTERNAL MAGNETIC SHIELD AND CATHODE RAY TUBE		

CERTIFICATE UNDER 37 CFR 1.10
'Express Mail' mailing label number: EL669944417US
Date of Deposit: July 23, 2001
I hereby certify that this correspondence is being deposited with the United States Postal Service 'Express Mail Post Office To Addressee' service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C . 20231.

By: Omesh Singh
Name: Omesh Singh

PRELIMINARY AMENDMENT

Box PCT
Assistant Commissioner for Patents
Washington, D. C. 20231

Dear Sir:

In connection with the above-identified application filed herewith, please enter the following preliminary amendment:

IN THE ABSTRACT

Insert the attached Abstract page into the application as the last page thereof.

IN THE SPECIFICATION

A courtesy copy of the present specification is enclosed herewith. However, the World Intellectual Property Office (WIPO) copy should be relied upon if it is already in the U.S. Patent Office.

IN THE CLAIMS

Please amend claims 5 and 6 as follows:

5. (amended) The internal magnetic shield according to claim 1, wherein a straight cutting edge substantially parallel to a phosphor screen is formed at a bottom of each of the notches.

6. (amended) A cathode ray tube comprising:

an envelope having a front panel and a funnel;

a phosphor screen formed on an inner surface of the front panel;

a color selection electrode arranged to face the phosphor screen;

an electron gun placed in the funnel; and

an internal magnetic shield placed between the color selection electrode and the electron gun,

wherein said internal magnetic shield is the magnetic shield according to claim 1.

Please add new claims 7 and 8 as follows:

7. (new) The internal magnetic shield according to claim 2, wherein a straight cutting edge substantially parallel to a phosphor screen is formed at a bottom of each of the notches.

8. (new) A cathode ray tube comprising:

an envelope having a front panel and a funnel;

a phosphor screen formed on an inner surface of the front panel;

a color selection electrode arranged to face the phosphor screen;

an electron gun placed in the funnel; and

an internal magnetic shield placed between the color selection electrode and the electron gun,

wherein said internal magnetic shield is the magnetic shield according to claim 2.

REMARKS

The above preliminary amendment is made to remove multiple dependencies from claims 5 and 6 and to add new claims 7 and 8. A marked-up version of the claims is attached.

A new abstract page is supplied to conform to that appearing on the publication page of the WIPO application, but the new Abstract is typed on a separate page as required by U.S. practice.

Applicants respectfully request that the preliminary amendment described herein be entered into the record prior to calculation of the filing fee and prior to examination and consideration of the above-identified application.

If a telephone conference would be helpful in resolving any issues concerning this communication, please contact Applicants' primary attorney-of record, Douglas P. Mueller (Reg. No. 30,300), at (612) 371.5237.

Respectfully submitted,

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Dated: July 23, 2001

By _____
Douglas P. Mueller
Reg. No. 30,300

DPM/jlc

MARKED-UP VERSION SHOWING CHANGES PG 1/2.

CLAIMS

1. An internal magnetic shield for a cathode ray tube comprising:
a pair of opposing long side walls;
a pair of opposing short side walls; and
an opening enclosed by these side walls in an center,
wherein at least one pair of the long and short side walls are provided with notches having a substantially home-plate shape.

2. An internal magnetic shield for a cathode ray tube comprising:
a pair of opposing long side walls;
a pair of opposing short side walls; and
an opening enclosed by these side walls in an center,
wherein at least one pair of the long and short side walls are provided with notches, and each of the notches is formed by at least two pairs of opposing cutting edges with different orientations.

3. The internal magnetic shield according to claim 2, wherein one pair of the at least two pairs of opposing cutting edges are parallel to each other.

4. The internal magnetic shield according to claim 2, wherein one pair of the at least two pairs of opposing cutting edges are provided so that a width of the opposing cutting edges is increased from an electron gun side to a phosphor screen side.

5. The internal magnetic shield according to claim 1 or 2, wherein a straight cutting edge substantially parallel to a phosphor screen is formed at a bottom of each of the notches.

6. A cathode ray tube comprising:
an envelope having a front panel and a funnel;
a phosphor screen formed on an inner surface of the front panel;
a color selection electrode arranged to face the phosphor screen;
an electron gun placed in the funnel; and
an internal magnetic shield placed between the color selection electrode and the electron gun,
wherein said internal magnetic shield is the magnetic shield

MARKED-UP VERSION SHOWING CHANGES PG 2/2

according to claim 1[or 2].

DESCRIPTION

INTERNAL MAGNETIC SHIELD AND CATHODE RAY TUBE

Technical Field

The present invention relates to an internal magnetic shield provided in a cathode ray tube to reduce mislanding of an electron beam due to an external magnetic field such as geomagnetism, and to a cathode ray tube including the same.

Background Art

FIG. 11 shows a conventional cathode ray tube used in television receivers, computer displays, or the like. An electron beam 81 released from an electron gun 80 is deflected in vertical and horizontal directions by a deflection yoke 82 to scan the entire screen, so that images are reproduced. In this case, when the cathode ray tube is affected by an external magnetic field such as geomagnetism, the path of the electron beam 81 is distorted. Therefore, the electron beam 81 does not reach the desired position on a phosphor screen 84 formed on a front panel 83, resulting in mislanding. To deal with this problem, the cathode ray tube includes an internal magnetic shield 85 that provides a shield against geomagnetism or the like.

As shown in FIG. 12, the internal magnetic shield generally includes a pair of opposing long side walls 86, a pair of opposing short side walls 87, and an opening 88 formed in the center, or substantially V-shaped notches 89 formed on the short side walls 87 as shown in FIG. 13. Such V-shaped notches 89 are disclosed in JP 53 (1978)-15061 A, JP 7 (1995)- 192643 A, JP 5 (1993)-159713 A, or the like.

When a cathode ray tube, including the internal magnetic shield without notches on the short side walls 87 or with substantially V-shaped notches, is affected by an external magnetic field such as geomagnetism, the amount of mislanding tends to be larger in the periphery of the screen than in the center thereof. In particular, mislanding occurs significantly at the corners, i.e., edges, of the screen. Thus, the conventional internal magnetic shields cause non-uniform mislanding throughout the screen, so that the improvement of mislanding at the corners of the screen has been necessary, particularly for a cathode ray tube that requires high definition.

It is not preferable that the amount of mislanding varies depending

on the direction in which the cathode ray tube is oriented. To avoid this, it is preferable that the amount of mislanding due to geomagnetism in the tube-axis direction is substantially the same as that of mislanding due to geomagnetism in the horizontal direction perpendicular to the tube axis. However, it is difficult to reduce the amount of mislanding throughout the screen while achieving the balance between two mislandings by geomagnetism in different directions.

Disclosure of Invention

Therefore, with the foregoing in mind, it is an object of the present invention to provide an internal magnetic shield that can reduce mislanding of a deflected electron beam by an external magnetic field such as geomagnetism and prevent the displacement and unevenness of colors on the entire screen. It is another object of the present invention to provide an internal magnetic shield that easily can balance the amount of mislanding due to geomagnetism in the tube-axis direction and in the horizontal direction perpendicular to the tube axis while reducing mislanding throughout the screen. It is yet another object of the present invention to provide a cathode ray tube that can display favorable images with reduced displacement and unevenness of colors on the entire screen by including the above internal magnetic shield.

To achieve the above objects, a first internal magnetic shield for a cathode ray tube of the present invention includes a pair of opposing long side walls, a pair of opposing short side walls, and an opening enclosed by these side walls in the center. At least one pair of the long and short side walls are provided with notches having a substantially home-plate shape.

A second internal magnetic shield for a cathode ray tube of the present invention includes a pair of opposing long side walls, a pair of opposing short side walls, and an opening enclosed by these side walls in the center. At least one pair of the long and short side walls are provided with notches. Each of the notches is formed by at least two pairs of opposing cutting edges with different orientations.

The above first and second internal magnetic shields can reduce mislanding of a deflected electron beam by an external magnetic field such as geomagnetism and prevent the displacement and unevenness of colors on the entire screen. Moreover, they easily can balance the amount of mislanding due to geomagnetism in the tube-axis direction and in the

horizontal direction perpendicular to the tube axis while reducing mislanding throughout the screen.

A cathode ray tube of the present invention includes an envelope having a front panel and an funnel, a phosphor screen formed on the inner surface of the front panel, a color selection electrode arranged to face the phosphor screen, an electron gun placed in the funnel, and an internal magnetic shield placed between the color selection electrode and the electron gun. The internal magnetic shield is the magnetic shield according to the above first or second internal magnetic shield.

The above cathode ray tube can display favorable images with reduced displacement and unevenness of colors on the entire screen, regardless of the direction in which the cathode ray tube is oriented.

Brief Description of Drawings

FIG. 1 is a schematic perspective view of an internal magnetic shield according to Embodiment 1 of the present invention.

FIG. 2 is a side view of an internal magnetic shield according to Embodiment 1 of the present invention when viewed from the side of a short side wall.

FIG. 3 shows the relationship between the depth of a parallel notch portion and the amount of mislanding due to geomagnetism in the tube-axis direction of an internal magnetic shield according to Embodiment 1 of the present invention.

FIG. 4 is a side view of an internal magnetic shield according to Embodiment 1 of the present invention when viewed from the side of a short side wall, in which the width of a notch is changed.

FIG. 5 shows the relationship between the width of a notch and the amount of mislanding of an internal magnetic shield according to Embodiment 1 of the present invention.

FIG. 6 is a side view of an internal magnetic shield having another configuration of Embodiment 1 of the present invention when viewed from the side of a short side wall.

FIG. 7 is a schematic perspective view of an internal magnetic shield according to Embodiment 2 of the present invention.

FIG. 8 is a side view of an internal magnetic shield according to Embodiment 2 of the present invention when viewed from the side of a short side wall.

FIG. 9 shows the relationship between an inclination angle θ1 and the amount of mislanding of an internal magnetic shield according to Embodiment 2 of the present invention.

FIG. 10 is a cross-sectional view showing the schematic configuration of a color cathode ray tube of the present invention.

FIG. 11 is a schematic cross-sectional view of a conventional cathode ray tube.

FIG. 12 is a schematic perspective view of a conventional internal magnetic shield.

FIG. 13 is a schematic perspective view of another conventional internal magnetic shield.

Best Mode for Carrying Out the Invention

Hereinafter, the present invention will be described with reference to FIGS. 1 to 10.

Embodiment 1

FIG. 1 is a perspective view of an internal magnetic shield according to Embodiment 1 of the present invention.

The internal magnetic shield of this embodiment has a pair of opposing long side walls 1 substantially in the form of a trapezoid and a pair of opposing short side walls 2 substantially in the form of a trapezoid. These side walls are joined to form a part of the surface of a quadrilateral pyramid. An opening 3 enclosed by the long and short side walls 1,2 is formed in the center of the shield. The internal magnetic shield is placed in a cathode ray tube with the small-width side (the upper side of FIG. 1) facing an electron gun and the large-width side (the lower side of FIG. 1) facing a phosphor screen. An electron beam passes through the opening 3. The short side walls are provided with notches 4, each being formed from the ends of the short side walls 2 on the electron gun side to the phosphor screen side.

FIG. 2 is a side view of the internal magnetic shield in FIG. 1 when viewed from the side of the short side wall 2. The vertical direction of FIG. 2 corresponds to the direction of the tube axis of a cathode ray tube that includes the internal magnetic shield.

In FIG. 2, the notch 4 has a bilateral symmetry formed of a pair of opposing first cutting edges 5 and a pair of opposing second cutting edges 6. The first cutting edges 5 are parallel to each other. In the side view of FIG.

2, which is a projection of the internal magnetic shield in the direction parallel to the long side of the rectangular phosphor screen when the shield is installed in the cathode ray tube, each of the first cutting edges 5 is parallel to the tube axis as well. The second cutting edges 6 intersect to form a V shape, so that a bottom 8 of the notch 4 is provided. The ends of the second cutting edges 6 opposite to the bottom 8 are connected to the first cutting edges 5. Since the first and second cutting edges 5, 6 are formed in different directions, each of the connections between them has a bend 9. As described above, the notch 4 has a substantially home-plate shape. The notch 4 thus formed is provided symmetrically on each of two opposing short side walls 2.

Here, as shown in FIG. 2, an opening width of the notch 4 on the electron gun side (i.e., the distance between the ends 7 of the opening) is defined as L; a notch width of the parallel notch portion having a constant notch width (i.e., the portion of the first cutting edges 5) is defined as L1 (in this embodiment, L1 = L); a height of the internal magnetic shield (the length in the tube-axis direction) is defined as H; a depth of the parallel notch portion (the length in the tube-axis direction) is defined as H1; and a depth of the notch 4 (the length in the tube-axis direction) is defined as H2.

FIG. 3 shows the amount of mislanding at the corners of the screen due to geomagnetism in the tube-axis direction (hereinafter, referred to as "tube-axis geomagnetism"), when the internal magnetic shield for a cathode ray tube having a 25-inch diagonal size is used so that the notch width L1 and the depth H2 of the notch 4 are fixed, while the depth H1 of the parallel notch portion is changed. When H1 = 0, the notch 4 has a V shape.

As can be seen from the FIG. 3, the amount of mislanding at the corners of the screen due to the tube-axis magnetic field is decreased with increasing the depth H1 of the parallel notch portion of the notch 4. The reason for this is as follows: the tube-axis geomagnetism is drawn to the ends 7 of the opening and the first cutting edges 5, so that the magnetic field thus drawn cancels the force to be exerted by an external magnetic field such as geomagnetism on the electron beam traveling through its path to the phosphor screen within the internal magnetic shield. However, when H1 = H2, the shield effect against geomagnetism in the horizontal direction perpendicular to the tube axis (hereinafter, referred to as "horizontal geomagnetism") is reduced, causing an increase in the amount of mislanding due to the horizontal geomagnetism.

Depending on the type of tube, the notch width L1 may be changed as shown in FIG. 4 to achieve the balance in the amount of mislanding due to the tube-axis geomagnetism and the horizontal geomagnetism. FIG. 5 shows the amount of mislanding at the corners of the screen due to the tube-axis geomagnetism and that due to the horizontal geomagnetism, when the depth H1 of the parallel notch portion and the depth H2 of the notch 4 are fixed, while the notch width L1 is changed. Since the shield effect against the horizontal magnetic field is increased with the decrease in the notch width L1, the amount of mislanding due to the horizontal geomagnetism is reduced, while the amount of mislanding due to the tube-axis geomagnetism is increased. Moreover, two curves, representing the amount of mislanding due to the tube-axis geomagnetism and that due to the horizontal geomagnetism, intersect with each other. This indicates that the balance in the amount of mislanding due to the tube-axis geomagnetism and the horizontal geomagnetism can be achieved.

The bottom 8 of the notch 4 may be formed in the following manner instead of simply intersecting a pair of second cutting edges 6: as shown in FIG. 6, the second cutting edges 6 are connected via a straight cutting edge 8a substantially parallel to the phosphor screen or a circular arc portion (with a rounded corner). Also, the ends 7 of the opening and the bends 9 may be formed to have a circular arc shape (with a rounded corner).

Using the above internal magnetic shield can form a diamagnetic field that cancels the force to be exerted by an external magnetic field such as geomagnetism on the electron beam traveling through its path to the phosphor screen. As a result, the force exerted on the electron beam is reduced, which leads to a reduction in mislanding caused by the distortion of the electron beam path. Thus, the displacement and unevenness of colors can be prevented on the entire screen. Moreover, this embodiment easily can balance the amount of mislanding due to the tube-axis geomagnetism and the horizontal geomagnetism perpendicular to the tube axis while reducing mislanding throughout the screen.

Embodiment 2

FIG. 7 is a perspective view showing an internal magnetic shield of Embodiment 2 of the present invention.

The internal magnetic shield of this embodiment has a pair of opposing long side walls 1 substantially in the form of a trapezoid and a pair of opposing short side walls 11 substantially in the form of a trapezoid.

These side walls are joined to form a part of the surface of a quadrilateral pyramid. An opening 3 enclosed by the long and short side walls 1, 11 is formed in the center of the shield. The short side walls 11 are provided with notches 12, each being formed from the ends of the short side walls 11 on the electron gun side to the phosphor screen side.

The notches 12 on the short side walls 11 of Embodiment 2 have a shape different from that of the notches 4 of Embodiment 1.

FIG. 8 is a side view of the internal magnetic shield in FIG. 7 when viewed from the side of the short side wall 11. The vertical direction of FIG. 8 corresponds to the direction of the tube axis of a cathode ray tube that includes the internal magnetic shield.

In FIG. 8, the notch 12 has a bilateral symmetry formed of a pair of opposing first cutting edges 13 and a pair of opposing second cutting edges 14. In the side view of FIG. 8, which is a projection of the internal magnetic shield in the direction parallel to the long side of the rectangular phosphor screen when the shield is installed in the cathode ray tube, each of the first cutting edges 13 is inclined at an angle of $\theta 1$ with respect to the tube axis, and each of the second cutting edges 14 is inclined at an angle of $\theta 2$ with respect to the tube axis. The second cutting edges 14 intersect to form a V shape, so that a bottom 16 of the notch 12 is provided. The ends of the second cutting edges 14 opposite to the bottom 16 are connected to the first cutting edges 13. Since the first and second cutting edges 13, 14 are formed in different directions, each of the connections between them has a bend 17. The notch 12 thus formed is provided symmetrically on each of two opposing short side walls 11.

As described above, the notch 12 is formed by two pairs of opposing cutting edges 13, 14 with different orientations. Therefore, like Embodiment 1, the tube-axis geomagnetism is drawn to the ends 15 of the opening and the first cutting edges 13, so that the magnetic field thus drawn cancels the force to be exerted by an external magnetic field such as geomagnetism on the electron beam traveling through its path to the phosphor screen within the internal magnetic shield. As a result, the amount of mislanding is reduced. However, when an inclination angle of $\theta 2$ is equal to that of $\theta 1$, the shield effect against the horizontal geomagnetism is reduced, causing an increase in the amount of mislanding due to the horizontal geomagnetism.

FIG. 9 shows the amount of mislanding due to the tube-axis

geomagnetism and that due to the horizontal geomagnetism, when the internal magnetic shield for a cathode ray tube having a 25-inch diagonal size is used so that the length of each of the first cutting edges 13 in the tube-axis direction is fixed, while the inclination angle θ1 is changed. Here, the angle θ1 is defined to have a positive sign when a pair of first cutting edges 13 are inclined in such a direction that the distance between the bends 17 is smaller than that between the ends 15 of the opening, as shown in FIG. 8. As shown in FIG. 9, two curves, representing the amount of mislanding due to the tube-axis geomagnetism and that due to the horizontal geomagnetism, intersect with each other. This indicates that the balance in the amount of mislanding due to the tube-axis geomagnetism and the horizontal geomagnetism can be achieved. When the inclination angle θ1 of the first cutting edges 13 is reduced to 0° or less, the amount of mislanding due to the tube-axis geomagnetism can be reduced without changing the amount of mislanding due to the horizontal geomagnetism significantly.

Like Embodiment 1, the bottom 16 of the notch 12 may be formed in the following manner instead of simply intersecting a pair of second cutting edges 14: the second cutting edges 14 are connected via a straight cutting edge substantially parallel to the phosphor screen or a circular arc portion (with a rounded corner). Also, the ends 15 of the opening and the bends 17 may be formed to have a circular arc shape (with a rounded corner). Moreover, depending on the type of tube, the opening width L2 of the notch 12 on the electron gun side (i.e., the distance between the ends 15 of the opening) may be changed.

In the above explanation, the notch is formed by two pairs of opposing cutting edges 13, 14 with different orientations. However, it should be noted that the notch may be formed by three or more pairs of cutting edges with different orientations to achieve the balance of mislanding.

Using the above internal magnetic shield can form a diamagnetic field that cancels the force to be exerted by an external magnetic field such as geomagnetism on the electron beam traveling through its path to the phosphor screen. As a result, the force exerted on the electron beam is reduced, which leads to a reduction in mislanding caused by the distortion of the electron beam path. Thus, the displacement and unevenness of colors can be prevented on the entire screen. Moreover, this embodiment

easily can balance the amount of mislanding due to the tube-axis geomagnetism and the horizontal geomagnetism perpendicular to the tube axis while reducing mislanding throughout the screen.

Embodiment 3

FIG. 10 is a cross-sectional view of a color cathode ray tube 30 of the present invention taken along the tube axis in the vertical direction.

A front panel 31 and a funnel 32 are joined to form an envelope 33. A substantially rectangular phosphor screen 34 is formed on the inner surface of the front panel 31. A color selection electrode (e.g., a shadow mask) 35 is stretched by a frame 36 so as to be spaced away from the phosphor screen 34 and opposed thereto. The frame 36 is held with the front panel 31 by engaging an elastic supporting body (not shown) in the form of a plate spring with a panel pin (not shown), the elastic supporting body being provided on the circumferential surface of the frame 36 and the panel pin being planted on the inner surface of the front panel 31. An electron gun 37 is contained in a neck portion of the funnel 32. An internal magnetic shield 40 is mounted on the frame 36 on the electron gun 37 side of the frame 36. A deflection yoke 39 that deflects an electron beam 38 from the electron gun 37 for scanning is provided on the circumferential surface of the funnel 32.

In the above color cathode ray tube 30 of the present invention, the internal magnetic shield of Embodiment 1 or 2 is used as the internal magnetic shield 40.

As described above, the internal magnetic shield 40 can form a diamagnetic field that cancels the force to be exerted by an external magnetic field such as geomagnetism on the electron beam 38 traveling through its path to the phosphor screen 34. As a result, the force exerted on the electron beam 38 is reduced, which leads to a reduction in mislanding caused by the distortion of the electron beam path. Thus, images without the displacement and unevenness of colors on the entire screen can be displayed. Moreover, this embodiment easily can balance the amount of mislanding due to the tube-axis geomagnetism and the horizontal geomagnetism perpendicular to the tube axis while reducing mislanding throughout the screen. Therefore, even if the direction in which the cathode ray tube is oriented is changed, images with reduced displacement and unevenness of colors always can be displayed.

In the internal magnetic shields of Embodiments 1 to 3, the short

side walls have the notches. However, the present invention is not limited thereto. Depending on the purpose of the use of a cathode ray tube or the like, the same notches as those in the above embodiments may be formed on the long side walls instead of the short side walls, or they may be formed on both long and short side walls.

In the internal magnetic shield of Embodiments 1 to 3, the notches are formed by straight cutting edges. However, the present invention is not limited thereto. As long as the objects of the present invention can be achieved, the whole portion of each cutting edge or a part of it (e.g., the end of the cutting edge) may be curved slightly.

There is no particular limitation on the material of an internal magnetic shield of the present invention, and a material with high permeability, e.g., iron or the like, can be used like a conventional internal magnetic shield. Also, the internal magnetic shield of the present invention can be manufactured in the same manner as that for the conventional one, such as by pressing.

The invention may be embodied in other forms without departing from the spirit or essential characteristics thereof. The embodiments disclosed in this application are to be considered in all respects as illustrative and not limiting. The scope of the invention is indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are intended to be embraced therein.

CLAIMS

1. An internal magnetic shield for a cathode ray tube comprising:
a pair of opposing long side walls;
a pair of opposing short side walls; and
an opening enclosed by these side walls in an center,
wherein at least one pair of the long and short side walls are provided with notches having a substantially home-plate shape.

2. An internal magnetic shield for a cathode ray tube comprising:
a pair of opposing long side walls;
a pair of opposing short side walls; and
an opening enclosed by these side walls in an center,
wherein at least one pair of the long and short side walls are provided with notches, and each of the notches is formed by at least two pairs of opposing cutting edges with different orientations.

3. The internal magnetic shield according to claim 2, wherein one pair of the at least two pairs of opposing cutting edges are parallel to each other.

4. The internal magnetic shield according to claim 2, wherein one pair of the at least two pairs of opposing cutting edges are provided so that a width of the opposing cutting edges is increased from an electron gun side to a phosphor screen side.

5. The internal magnetic shield according to claim 1 or 2, wherein a straight cutting edge substantially parallel to a phosphor screen is formed at a bottom of each of the notches.

6. A cathode ray tube comprising:
an envelope having a front panel and a funnel;
a phosphor screen formed on an inner surface of the front panel;
a color selection electrode arranged to face the phosphor screen;
an electron gun placed in the funnel; and
an internal magnetic shield placed between the color selection electrode and the electron gun,
wherein said internal magnetic shield is the magnetic shield

according to claim 1 or 2.

ABSTRACT

An internal magnetic shield includes a pair of opposing long side walls (1), a pair of opposing short side walls (2), and an opening (3) enclosed by these side walls in the center. The short side walls (2) are provided with notches (4) having a substantially home-plate shape. This configuration can reduce mislanding of an electron beam on the entire screen and easily balance the amount of mislanding due to geomagnetism in the tube-axis direction and in the horizontal direction perpendicular to the tube axis. As a result, a cathode ray tube capable of displaying images without displacement and unevenness of colors can be provided.

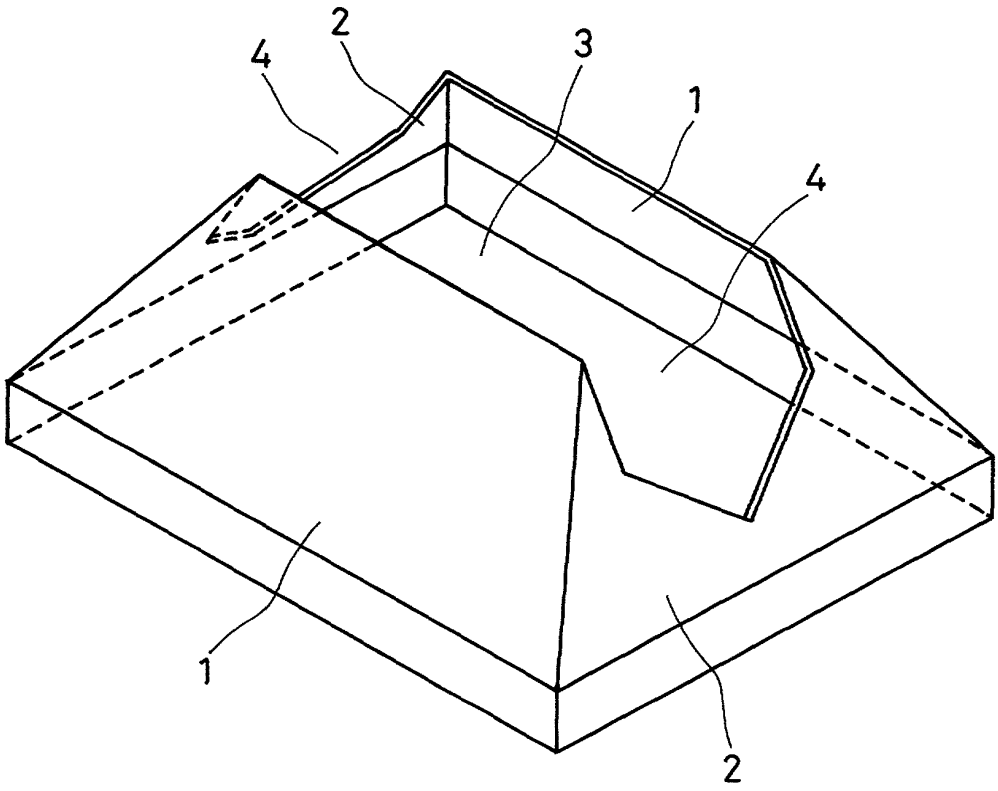

FIG. 1

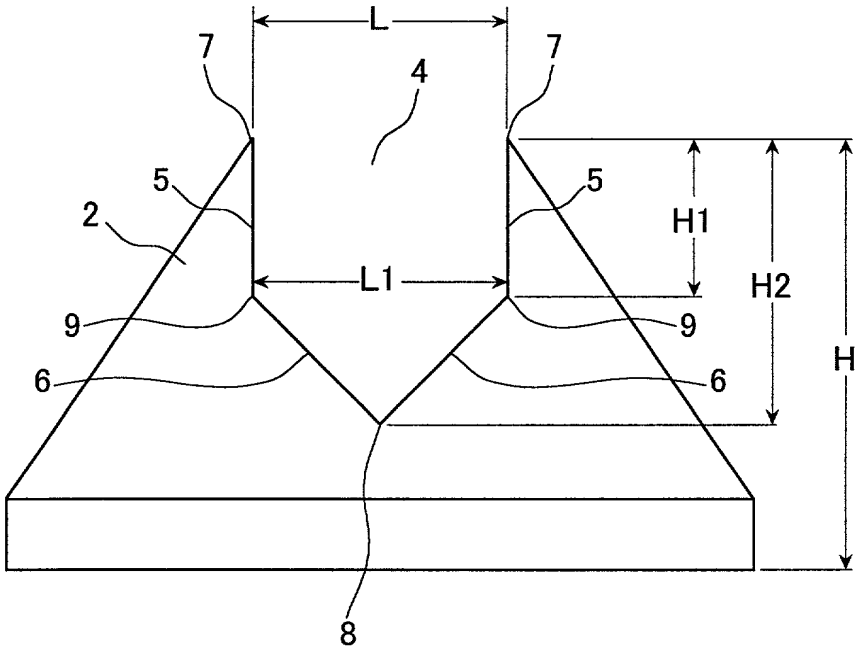

FIG. 2

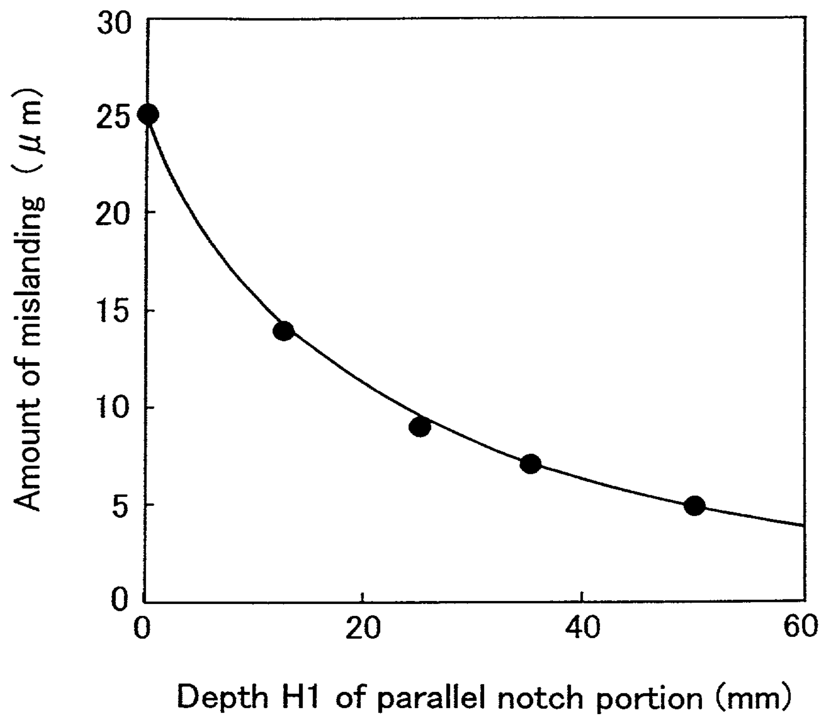

FIG. 3

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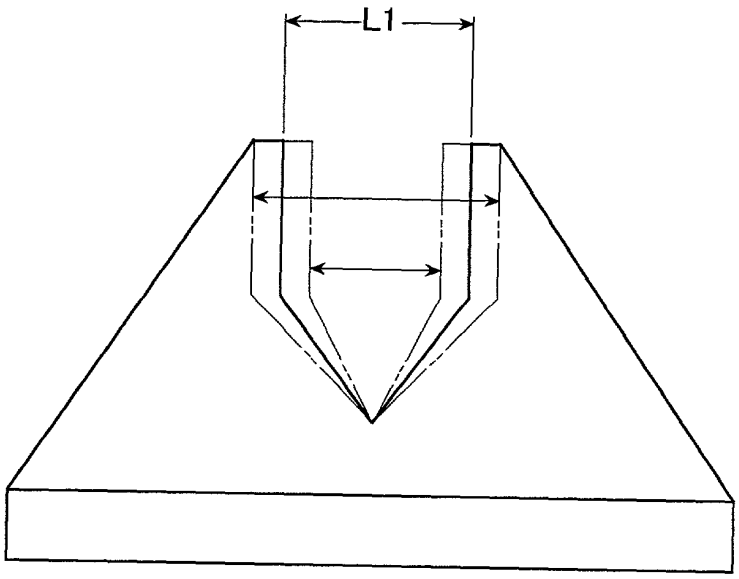

FIG. 4

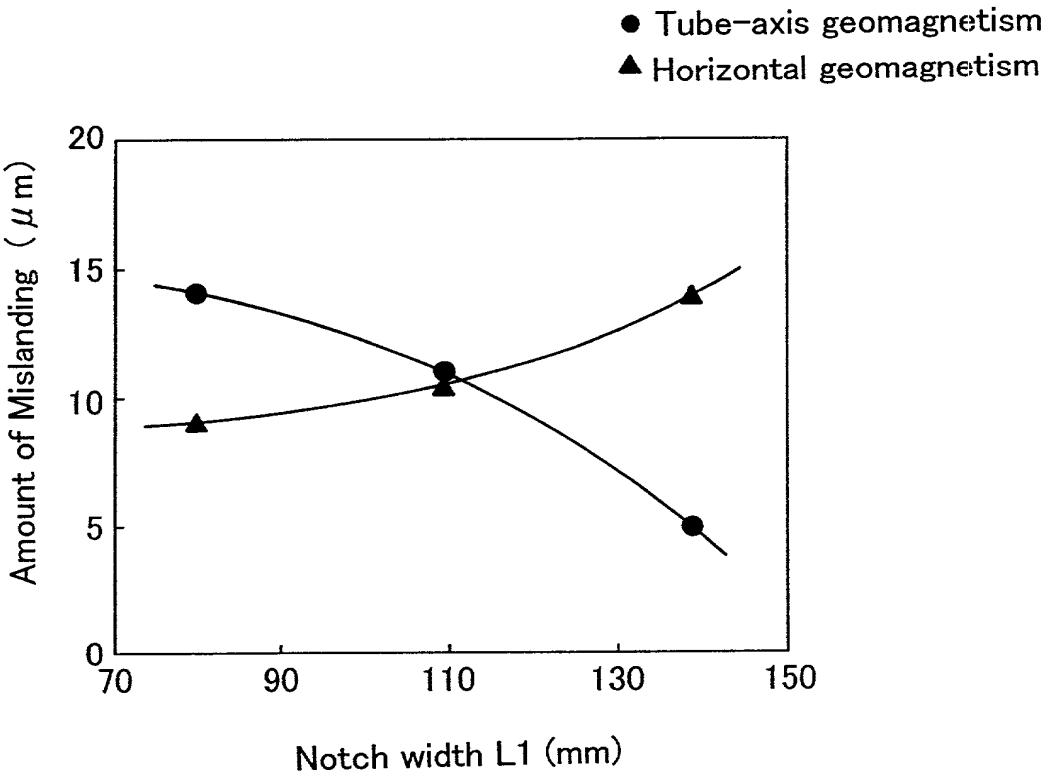

FIG. 5

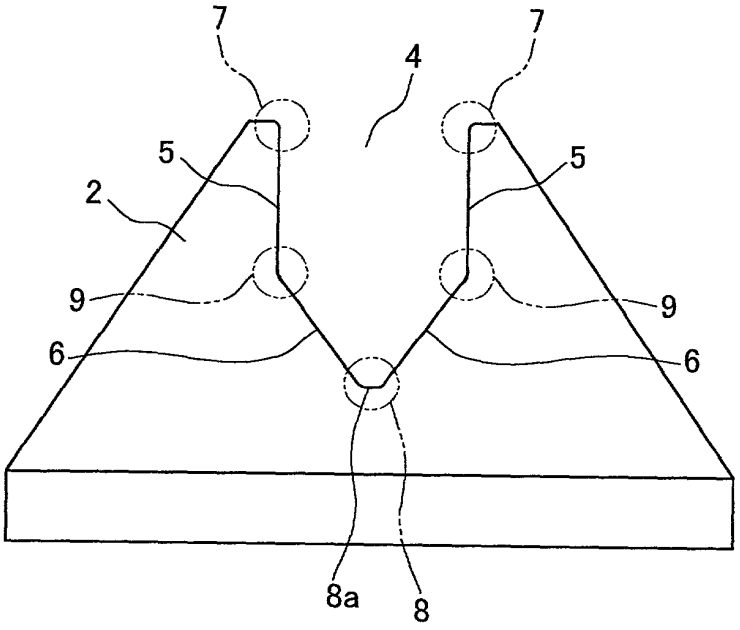

FIG. 6

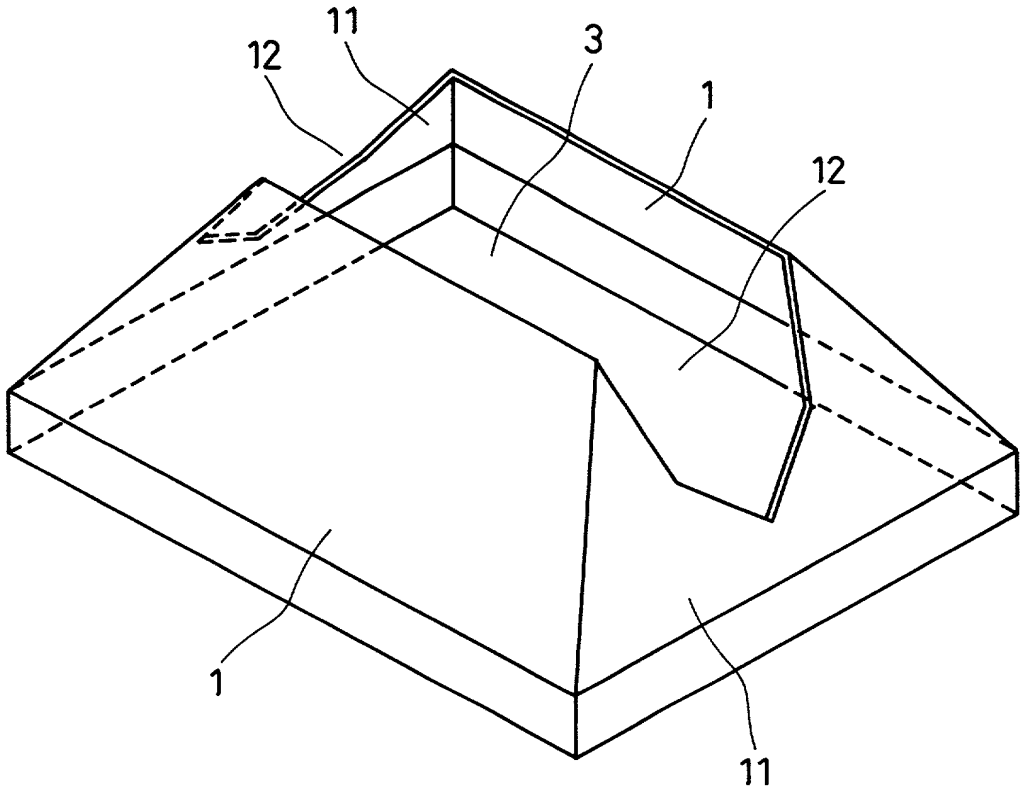

FIG. 7

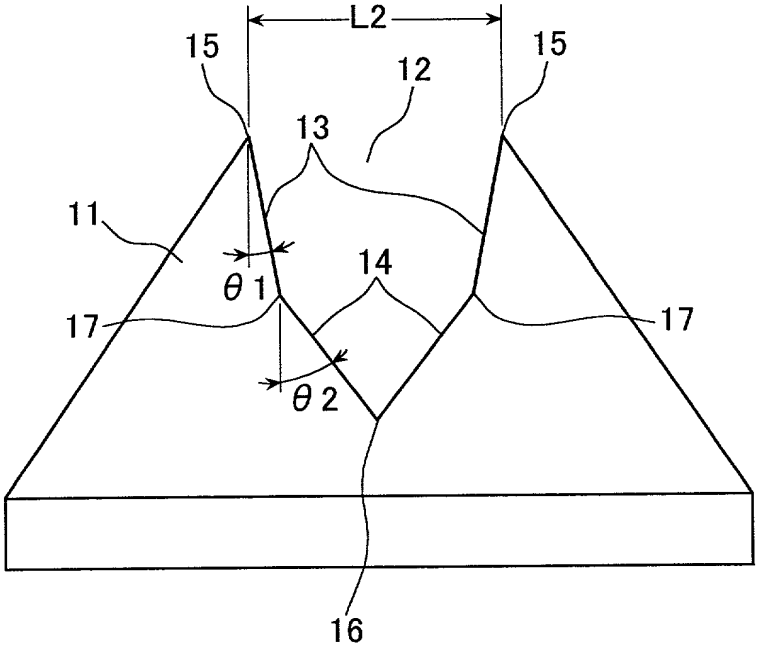

FIG. 8

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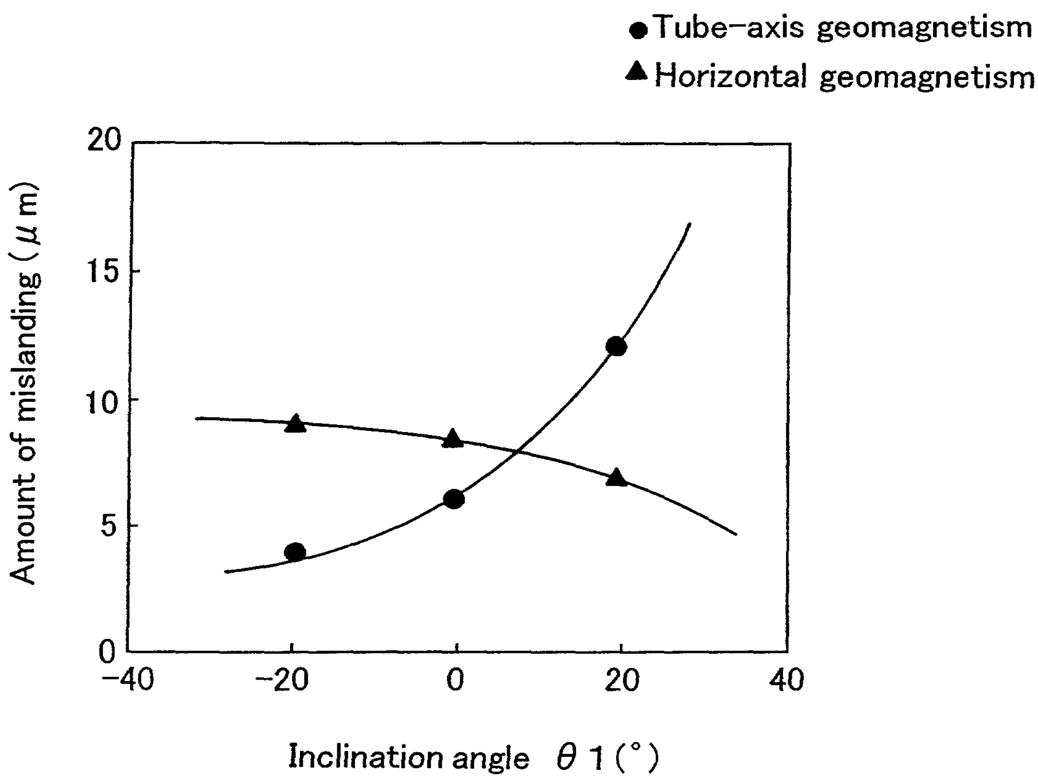

FIG. 9

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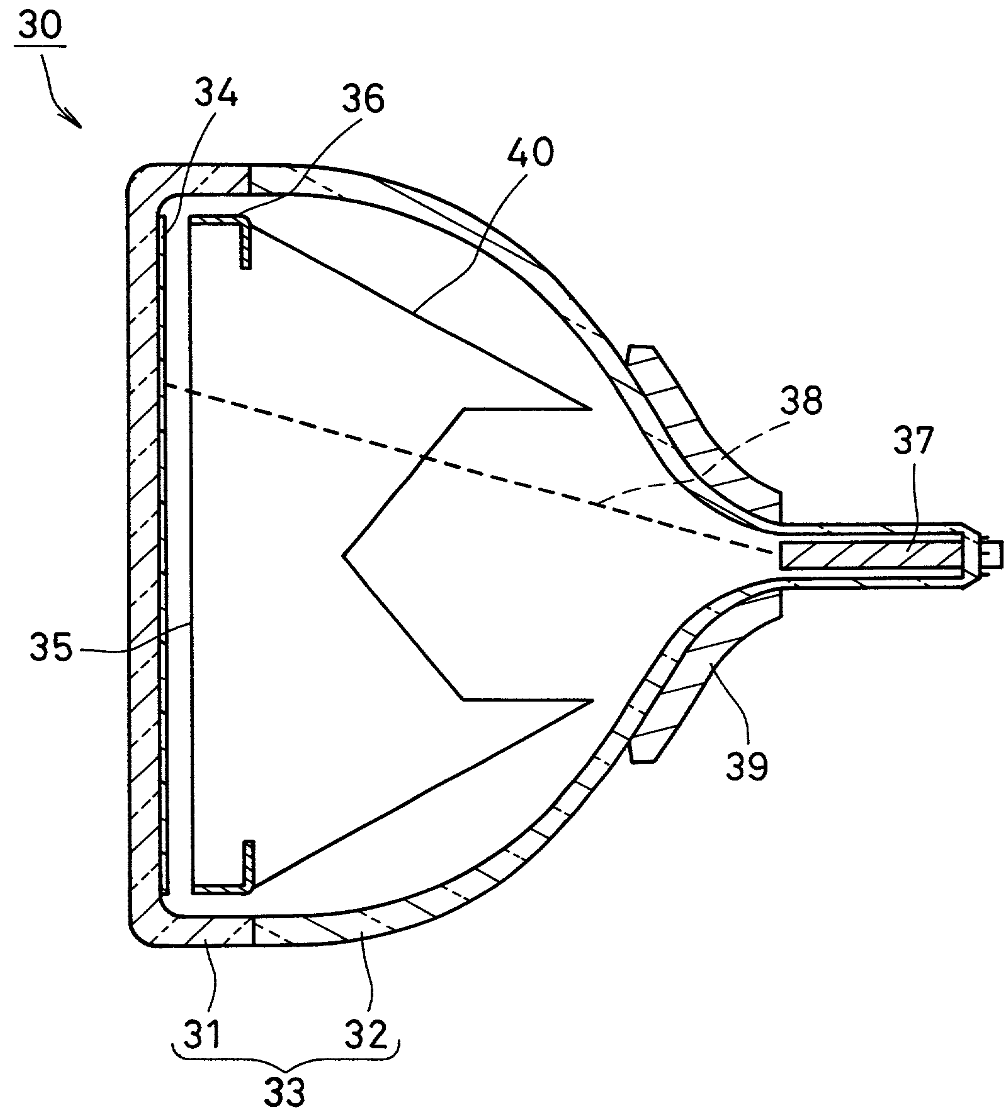

FIG. 10

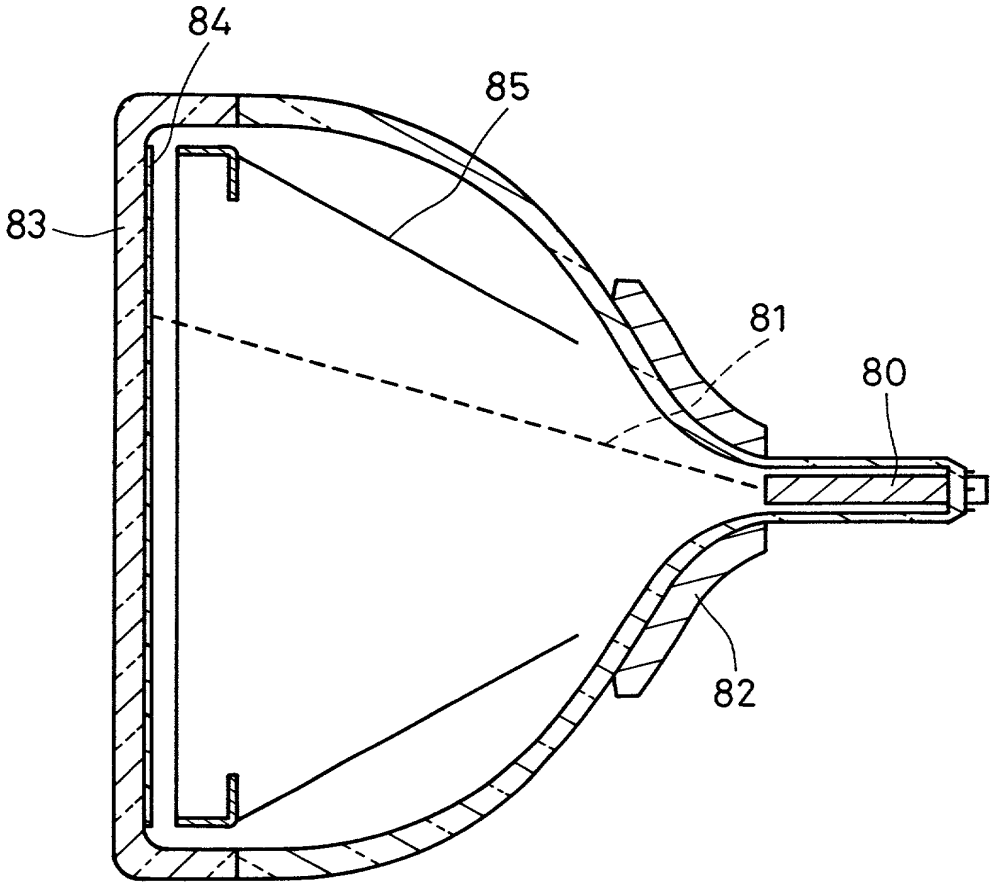

FIG. 11

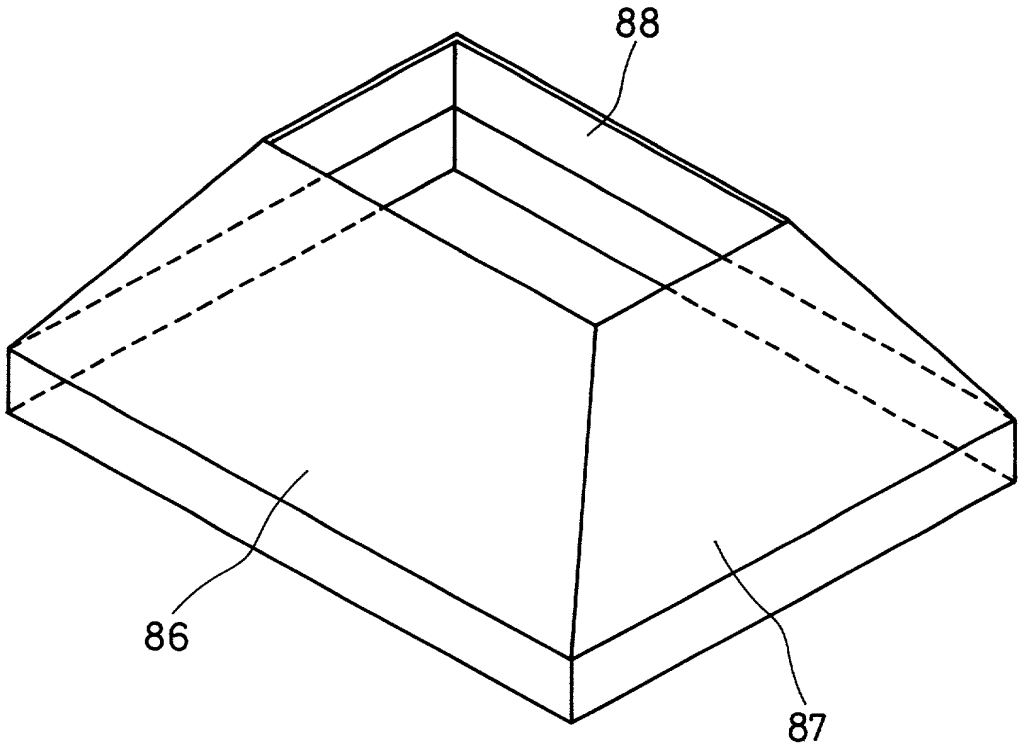

FIG. 12

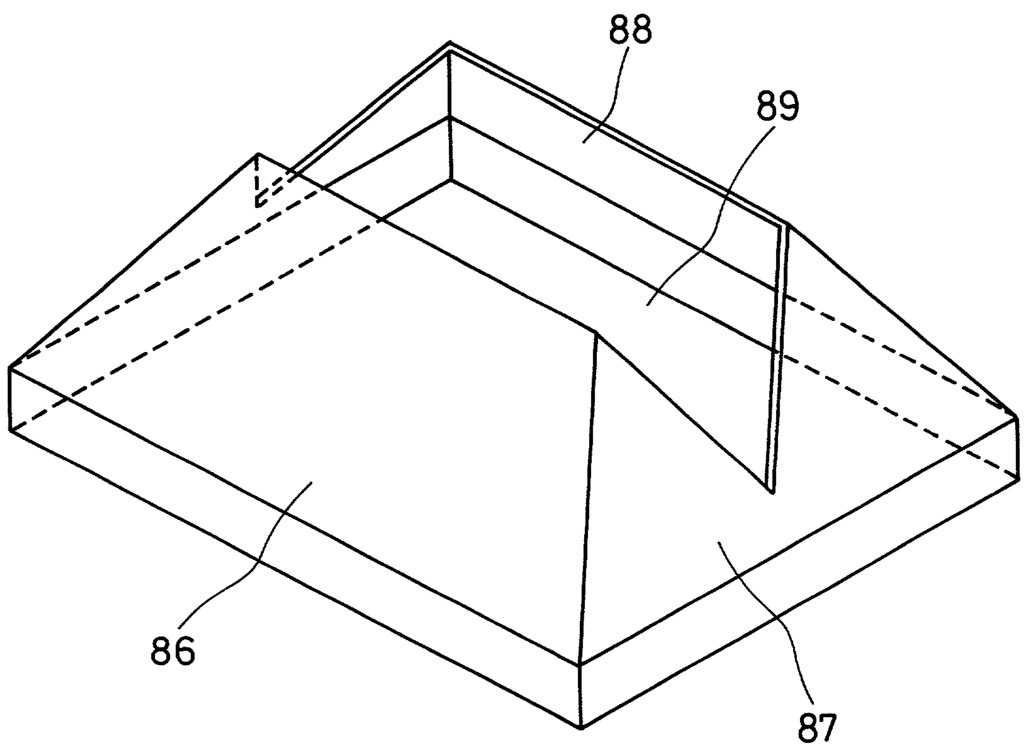

FIG. 13

Attorney Docket No. 10873.754USWO

MERCHANT & GOULD P.C.

United States Patent Application

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that

I verily believe I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: INTERNAL MAGNETIC SHIELD AND CATHODE RAY TUBE

The specification of which
a. ☐ is attached hereto
b. ☒ was filed on as application serial no. and was amended on (if applicable) (in the case of a PCT-filed application) described and claimed in international no. PCT/JP00/08316 filed November 24, 2000 and as amended on (if any), which I have reviewed and for which I solicit a United States patent.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119/365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on the basis of which priority is claimed:

a. ☐ no such applications have been filed.
b. ☒ such applications have been filed as follows:

FOREIGN APPLICATION(S), IF ANY, CLAIMING PRIORITY UNDER 35 USC § 119			
COUNTRY	**APPLICATION NUMBER**	**DATE OF FILING (day, month, year)**	**DATE OF ISSUE (day, month, year)**
Japan	11-352938	13 December 1999	
ALL FOREIGN APPLICATION(S), IF ANY, FILED BEFORE THE PRIORITY APPLICATION(S)			
COUNTRY	**APPLICATION NUMBER**	**DATE OF FILING (day, month, year)**	**DATE OF ISSUE (day, month, year)**

I hereby claim the benefit under Title 35, United States Code, § 120/365 of any United States and PCT international application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. APPLICATION NUMBER	DATE OF FILING (day, month, year)	STATUS (patented, pending, abandoned)

I hereby claim the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below:

U.S. PROVISIONAL APPLICATION NUMBER	DATE OF FILING (Day, Month, Year)

I acknowledge the duty to disclose information that is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, § 1.56 (reprinted below):

§ 1.56 Duty to disclose information material to patentability.

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is canceled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is canceled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application:

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

(e) In any continuation-in-part application, the duty under this section includes the duty to disclose to the Office all information known to the person to be material to patentability, as defined in paragraph (b) of this section, which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby appoint the following attorney(s) and/or patent agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith:

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Scull, Timothy B.	Reg. No. 42,137
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Wahl, John R.	Reg. No. 33,044
Weaver, Karrie G.	Reg. No. 43,245
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I hereby authorize them to act and rely on instructions from and communicate directly with the person/assignee/attorney/firm/ organization who/which first sends/sent this case to them and by whom/which I hereby declare that I have consented after full disclosure to be represented unless/until I instruct Merchant & Gould P.C. to the contrary.

I understand that the execution of this document, and the grant of a power of attorney, does not in itself establish an attorney-client relationship between the undersigned and the law firm Merchant & Gould P.C., or any of its attorneys.

Please direct all correspondence in this case to Merchant & Gould P.C. at the address indicated below:

Merchant & Gould P.C.
P.O. Box 2903
Minneapolis, MN 55402-0903

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Signature of Inventor 205: Shigeo Nakatera			**Date:** June 29, 2001	
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Signature of Inventor 206: Tomohisa Mikami			**Date:** June 29, 2001	

Each inventor must sign & date

Note: No legalization or other witness required

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Shinichiro Hatta Signature SHIN-ICHIRO HATTA	July 2, 2001 Date
Ryuichi Murai Signature RYUICHI MURAI	July 2, 2001 Date
Masaki Kawasaki Signature MASAKI KAWASAKI	June 29, 2001 Date
Shigeo Nakatera Signature SHIGEO NAKATERA	June 29, 2001 Date
Tomohisa Mikami Signature TOMOHISA MIKAMI	June 29, 2001 Date